Changing travel patterns in regions with population decline

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Samenvatting

'Bevolkingsdaling' en 'verstedelijking' belichten in feite twee kanten van dezelfde medaille. Door een trek naar de stad krimpt de omvang en verandert de samenstelling van de bevolking in rurale gebieden. Dit kan een kettingreactie veroorzaken. Voorzieningen zoals scholen en ziekenhuizen, maar ook winkels trekken uit kleinere kernen weg om zich al dan niet te clusteren in grotere plaatsen. Dit kan een verslechtering van de bereikbaarheid en leefbaarheid van dorpen tot gevolg hebben, waardoor inwoners en bedrijven op hun beurt mogelijk besluiten om te verhuizen. In dit artikel gebruiken we de zogenaamde nabijheidsstatistiek van het CBS (jaren 2008 en 2015) en data van het Onderzoek Verplaatsingen in Nederland (tussen 2005 en 2015) om meer inzicht te krijgen in welke mate de nabijheid van voorzieningen en de mobiliteit van inwoners in Nederlandse krimpgebieden door de tijd is veranderd. Onze analyses laten zien dat de gemiddelde afstand tot voorzieningen tussen 2008 en 2015 in het hele land is toegenomen. In meer rurale (krimpende) gebieden lijkt deze toename sterker. Een aanvullende analyse duidt echter niet op een statisch sterke correlatie tussen bevolkingsdaling en de afstand tot voorzieningen. De verschraling van voorzieningen lijkt daarom misschien wel eerder het gevolg van schaalvoordelen (‘economies of scale’) dan van bevolkingskrimp. Met het oog op veranderingen in mobiliteitspatronen tussen 2005 en 2015, vinden we in krimpgebieden een relatief sterkere groei in het aantal kilometers en verplaatsingen per inwoner dan in niet-krimpgebieden. Overall is het aantal afgelegde kilometers in beide gebieden toegenomen. In krimpgebieden komt dit ondanks de bevolkingsdaling vooral door het vaker en verder reizen van inwoners, terwijl dit in ‘overig Nederland’ vooral wordt veroorzaakt door de absolute groei in bevolkingsomvang (‘meer mensen’). Ook reizen mensen in groeigebieden verder, maar wel minder vaak. In vervolgonderzoek maken we een verdere uitsplitsing naar mobiliteitstrends per vervoerwijze. Dit geeft mogelijk ook een verklaring voor de gevonden afname van het aantal verplaatsingen per inwoner in groeigebieden.

1. Introduction

'Population decline' and 'urbanization' in developed countries illuminate in fact two sides of the same coin. A 'pull' to the city shrinks the size and changes the composition of the population in outlying regions. This can cause a chain reaction. Public (e.g. schools, hospitals) and private (e.g. retail) facilities may pull away and / or cluster in larger villages. This has direct impact on the viability and liveability of such areas. The displacement and decrease in provisions may also affect accessibility of activity locations and travel patterns.
The manner in which travel patterns develop is a complex process, which depends on changes in the size and composition of the population and changes in behaviour. Fewer people in an area ('size') means less travel at the macro level. Additionally, travel patterns are influenced by the composition of the population and trends therein (more elderly, more single households). Other lifestyles and living patterns may also change individual behaviour.

Although the population in the Netherlands is increasing as a whole in the coming decades (with 1 million inhabitants to 2030), large spatial differences can be distinguished. Growth is expected primarily in the Randstad and in its foothills: Almere, Arnhem, Breda, Tilburg and Eindhoven (KiM 2010). However, especially some regions in the north (i.e. provinces of Groningen, Friesland and Drenthe), the southwest (province of Zeeland) and the southeast (i.e. southern part of the province of Limburg) face population decline. This process started somewhere in the second half of the 1990s. Forecasts indicate, furthermore, that around 2040 one third of all municipalities in the Netherlands will be confronted with a decrease in the number of households whereas the potential labour force is expected to decrease in almost all municipalities (PBL 2013). Population decline has various effects (for an extensive overview, see PBL 2013). First, if less people coincides with less households, fewer houses are needed and regions might be confronted with vacant homes. Second, fewer children might reduce the support of elementary (and secondary) schools, which could result in closings or mergings of existing schools. Third, a decline in the size of the potential labor force (population aged 20 to 65 year) might result in labour shortages, such as in technical sectors and in health care. Fourth, the support of certain facilities and services such as supermarkets, might decrease as well. Last but not least, the accessibilty and travel patterns might change. Especially people with low mobility such as the elderly, low income groups or other people without motorized transport could be vulnerable to the impact of population decline (e.g. Christiaanse & Haartsen 2017).

In this paper we aim to gain greater insight into this last mentioned effect of population change: to what extent do population decline influence the accessibility of activity locations and travel patterns in (peripheral) regions in the Netherlands. These analyses may give greater insight that may add to quality of life issues and discussions (e.g. 'transport poverty') in regions facing population decline.

The outline of this paper is as follows: Section 2 summarizes existing findings on the mobility effects of demographic changes. Section 3 considers the data characteristics and defines the methodological steps. Section 4 presents impacts of population decline on the accessibility of activity locations (section 4.1) and analyses changes in travel behaviour over time. Finally, section 5 presents our discussion and conclusions.

2. Theoretical framework

2.1 Population change in Europe

Whereas some peripheral regions in the Netherlands are facing population decline, the overall population in the country still increases with around 0,5 percent per year (period 2014-2016; Eurostat, 2017). This is primarily due to the attractiveness of urban areas which result in younger often more highly educated people to leave peripheral regions where opportunities for development (e.g., jobs) are lower. This trend where some regions of countries are doing better and attract people at the expense of other regions can be seen in many developed countries in North-western Europe.

Of the EU-28, 10 Member States reported a reduction in population size during 2015 which may have different demographic reasons. Some countries recorded a decline largely as a result of negative net migration, for instance Croatia, Latvia and Lithuania), whereas in other, often (also) Eastern European countries, the decrease was mostly driven due to a negative rate of natural population change.

Figure 1: demographic drivers for population change for EU countries

Demographic drivers	EU Member States, EFTA countries and enlargement countries
Growth due:	
only to natural change	Montenegro, the former Yugoslav Repulic of Macedonia
more to natural change	Ireland, France, Cyprus, Slovakia, Liechtenstein, Turkey
more to positive net migration (and adjustment)	Belgium, Czech Republic, Denmark, Luxembourg, Malta, the Netherlands, Austria, Slovenia, Sweden, the United Kingdom, Iceland, Norway, Switzerland
only to positive net migration (and adjustment)	Germany, Spain, Poland, Finland
Decline due:	
only to natural change	Estonia, Italy, Serbia, Bosnia and Herzegovina
more to natural change	Bulgaria, Greece, Hungary, Portugal, Romania
more to negative net migration (and adjustment)	Croatia, Latvia, Lithuania
only to negative net migration (and adjustment)	

Source: Eurostat (online data code: demo_gind)

2.2 Demographic decline in the Netherlands

Three types of demographic decline can be distinguished (PBL 2010): 1) a decrease in the number of inhabitants; 2) a decrease in the number of households; 3) a decrease in the potential labour force. Developments in the size of the latter two are in certain ways as relevant for the development of the regional economy and the housing market as the number of inhabitants. However, the debate often revolves around changes in the number of inhabitants (PBL, 2010).

PBL (2010) defines three causes for demographic decline. The first includes social-cultural developments such as individualization and emancipation. The second and third can respectively be defined as regional-economic developments (e.g., business activities and employability) and planning related decisions (e.g., location of new housing). Social-cultural developments mainly influence the natural change in population due to birth and death whereas the other two primarily influence migration and relocation movements.

According to population statistics for the Netherlands, in the period 2005 – 2015 the number of inhanbitants decreased especially in the northernmost municipalities and northeastern part of the Netherlands (in some cases with -10% or more), and in parts of Limburg and Zeeland (figure 2).

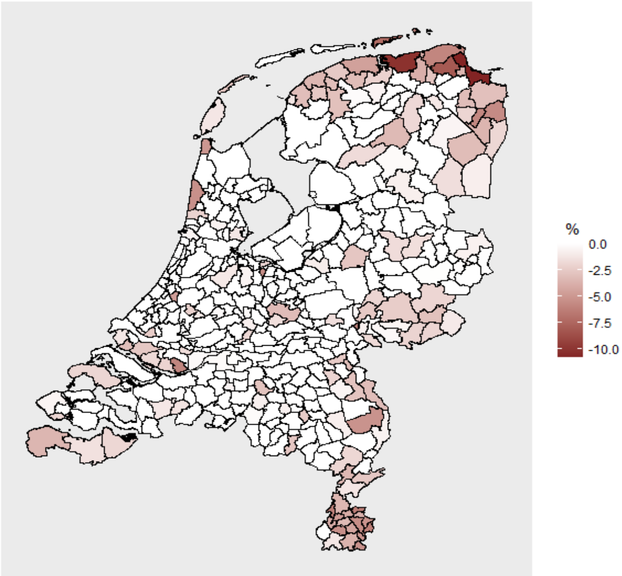


Figure 2: population decline (in %) in the Netherlands, 2005 – 2015. Source: Statistics Netherlands.

Projections for the period up to 2050 show large regional differences between two scenarios in which economic growth and economic decline are forecasted (PBL/CPB 2015; figure 3). In the scenario with high economic growth, population decline is only foreseen in the northeastern and southwestern parts of the Netherlands (rightside figure), whereas in the scenario with lower economic growth many Dutch regions will be confronted with population decline (leftside figure). In other words: there is much uncertainty whether or not regions will be confronted with population decline and its degree. Nonetheless, since the mid 1990s, more and more municipalities have been faced with the challenge of less inhabitants (see figure 2).

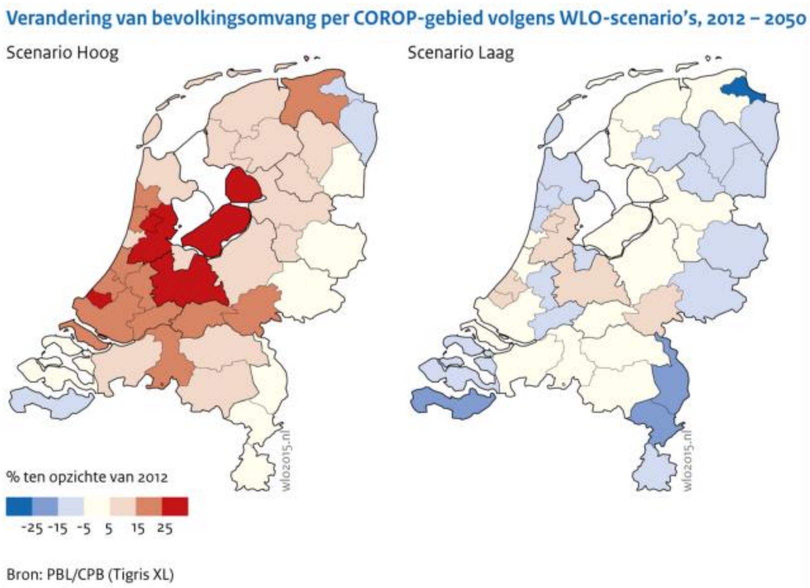


Figure 3: scenario's for increase and decrease in population (in %) in the Netherlands, 2012 – 2050. Source: PBL/CPB 2015

2.3 Demographic decline and transport mobility

What are the effects of demographic changes on transport mobility? In general, developments in the total regional transport mobility are the result of changes in the volume and composition of the population and (individual) changes in travel behaviour, due to changing lifestyles and activity patterns. Population growth results in an increase in the total number of people travelling and thereby to increasing mobility (more trips). In addition, a change in composition of the population will result in an in- or decrease of mobility (more or less trips, shorter or longer distances). An example is the increase in the number of people over 65 years, which results in less work related trips and more recreational trips (e.g. Arentze et al 2008). In addition, changing lifestyles and activity patterns have an impact on per capita travel behaviour. For instances, socio-cultural developments such as changes in preferences and needs with respect to the family, marriage, the position of women or household responsibilities can have an impact on car usage (Olde Kalter, Jorritsma & Harms 2009; Harms, Olde Kalter & Jorritsma 2010).

Earlier Dutch research based on forecasts with the Dutch National Model has shown that the impact of population decline on mobility is expected to be limited (KiM, 2010). In regions with a shrinking population, transport mobility will still increase, but at a lower rate. This is mainly due to other, non-demographic factors, like economic development and social-cultural changes: If only population size and composition would change, all other conditions remaining equal, then a shrinking population would result in some regions to a reduction in car use. But due to non-demographic factors like socio-economic developments the expected net effect for 2030 is an increase in car use (figure 4).

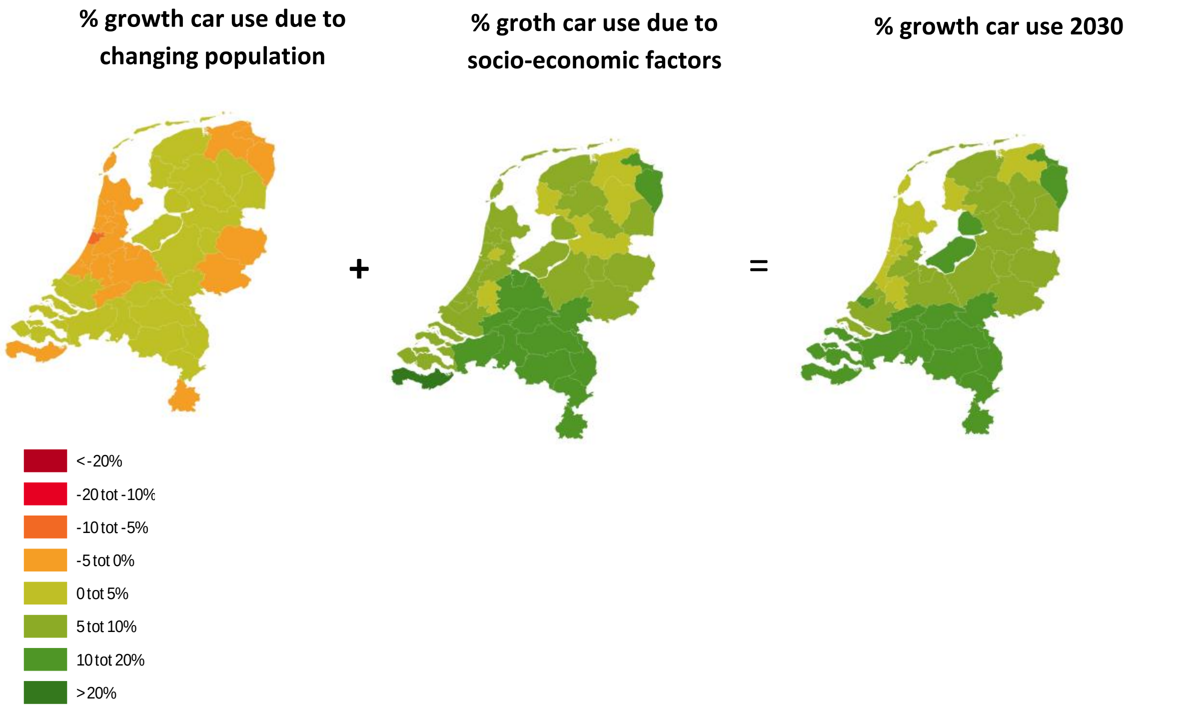


Figure 4: Increase in car use on the main road network in the Netherlands (2030), distinguished by changing population numbers and socio-economic factors. Source: KiM 2010

A more recent study of PBL (2013), using the same National Model, has come to a comparable conclusion: population size does impact transport mobility volumes but other, socio-economic factors have a larger impact. In addition, the population composition is important as well, e.g. more elderly people implies less workrelated traffic and more recreational trips.

The above studies reflect on the macro effects of population changes on total traffic volumes and car use. Other studies focus on the impacts on accessibility and car dependency on an individual level. For the Netherlands these effects seem to be limited, since most of the countryside is (according to international standards) relelatively densely populated and has a well-developed road and public transport network. In other words: for most people in the Netherlands, access should not be an issue (Steenbekkers and Vermeij 2013). In addition, a recent evaluation on changes in the supply of public transport services in Dutch northern provinces, shows that the accessibility of locations by public transport in peripheral regions has not significantly changed since 2010 (Noordelijke Rekenkamer 2010). But people with low mobility such as the elderly, low income groups or other people without motorized transport, could be vulnerable to the accessibility impacts of population decline (Higgs and Langford 2013; Milbourne and Kitchen 2014). Apart from actual changes, the perception of changes in accessibilty might also impact individual mobility choices (Christiaanse & Haartsen 2017).

3. Methodology

In this paper we use two different types of data. Our first analysis focuses on the extent to which population decline has changed the accessibility of activity locations between 2008 and 2015. We use data from Statistics Netherlands on distances from zip code centroids (4766 in total) to different types of activity locations (see Table 1), which include amongst other supermarkets, (non) daily shops and warehouses, medical facilities, and primary and secondary education. Although the population in certain peripheral regions in the Netherlands already started declining around the mid-90s, we only have access to data from 2008-2015. We both analyze 1) the average distance (by road network) from all inhabitants in a zip code zone to the nearest activity location, and, 2) the number of activity locations that are accessible by inhabitants of a zone within different distance classes (by road network) depending on the type of activity location. Both indicators together provide detailed analysis of potential accessibility changes over time.

Table 1: type of activity locations included in the accessibility analysis

Type of activity location	Distance classes
General practioner	1, 2, 5 km
Hospital (excluding the policlinic facilities)	5, 10, 20 km
Hospital (including the policilinic facilities	5, 10, 20 km
Super market (daily groceries)	1, 3, 5 km
Other shops (daily shopping)	1, 3, 5 km
Warehouses	5, 10, 20 km
Primary education	1, 3, 5 km
Secondary education	3, 5, 10 km

The following steps were taken:

- We classified the zip codes according to population density using the Statistics Netherlands definition for 'urban degree' into five classes. Subsequently, codes 1-3 were combined and labelled as 'urban' and 4-5 as 'non-urban'.
- The non-urban areas (code 4-5) were further categorized into areas that faced population decline in the period 2008-2015 and areas where population increased in that same period.
- Finally, the areas were linked to whether they are located in one of the indicated 'shrinkage' regions in the provinces of Groningen, Limburg and Zeeland, or whether they are located in other parts of the country, i.e.: 'Netherlands rest'. Groningen, Limburg and Zeeland are chosen because they are well known regions that already (partly) face population decline. Moreover, we link these regions to the degree of urbanity. Especially in cores that are small and already contain a low number of facilities, population decline may have direct impact on the availability of services and on liveability.

Table 2: characterization of degree of urbanization (Source: CBS Statline)

Characterization of degree of urbanization	Address density	Code
Very strongly urban	>= 2500-1000 per km^2	1
Strongly urban	1500-2500 per km^2	2
Moderately urban	1000-1500 per km^2	3
Hardly urban	500-1000 per km^2	4
Not urban	<= 500 per km^2	5

3.3 Analysis of changes in trip frequency and trip distance

With the second analysis we aim to gain insight into changes in number of trips made and in distances travelled (averaged over all transport modes) between 2005, when population decline in certain peripheral Dutch regions was already going on for some years, and 2015. We use data from the yearly Dutch National Travel Survey (OViN). Analyses are conducted on a higher level of aggregation. We choose the municipal level (around 400 in the Netherlands) as basis for our analysis because the cross section data set does not provide sufficient travel data for reliable analysis at the more detailed zip code level. For comparative reasons, general descriptive analyses are carried out for (roughly) the same categorization as used for the analysis of accessibility changes of activity locations. In addition, more specific analyses are carried out using a more simple categorization, where the country is divided into municipalities that either faced population decline or growth between 2005 and 2015. Both categorizations used are shown in Figure 5.

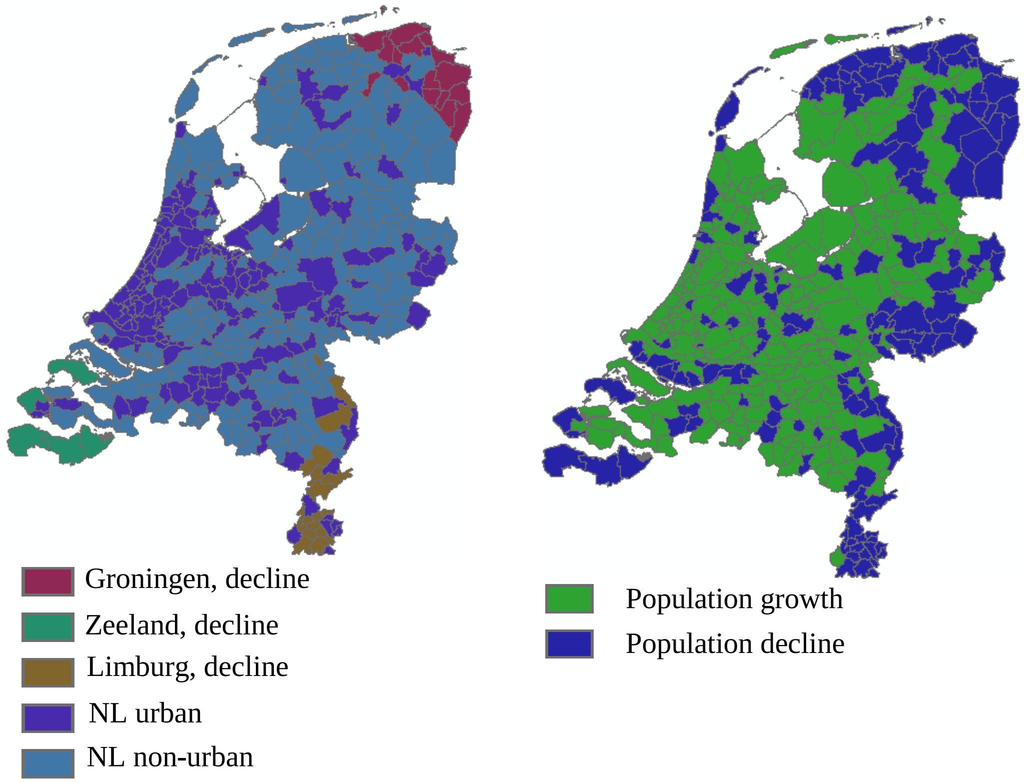


Figure 5: Categorization of Dutch regions that is used in the analysis of the accessibility of activity locations (i.e. facilities).

4. Results

4.1 Changes in activity location accessibility

In this section we look first at the average distance to different types of facilities (see also Table 1) and the changes that occurred between 2008 and 2015. Secondly, we analyse to what extent the number of facilities available within a certain distance have changed. In addition, we distinguish between urban Netherlands (urbanization level 1 to 3), non-urban Netherlands (urbanization degree 4, 5) and urban areas (urbanization degree 4, 5) with population shrinkage in the three provinces of Groningen, Zeeland and Limburg.

The analyses show that by 2015 the average distance to the main daily facilities in the non-urban areas is almost 2,5 times as high as in urban areas (Figure 6). The non-urban areas do not differ much from the areas under investigation. Residents of shrinkage areas in Groningen and Zeeland must bridge the largest distance to reach those facilities. This applies especially to hospitals, department stores and schools for secondary education. For example, residents of the shrinkage areas in Groningen are on average 14 km remote from a hospital, while residents of shrinkage areas in Limburg have to travel an average of 9 km.

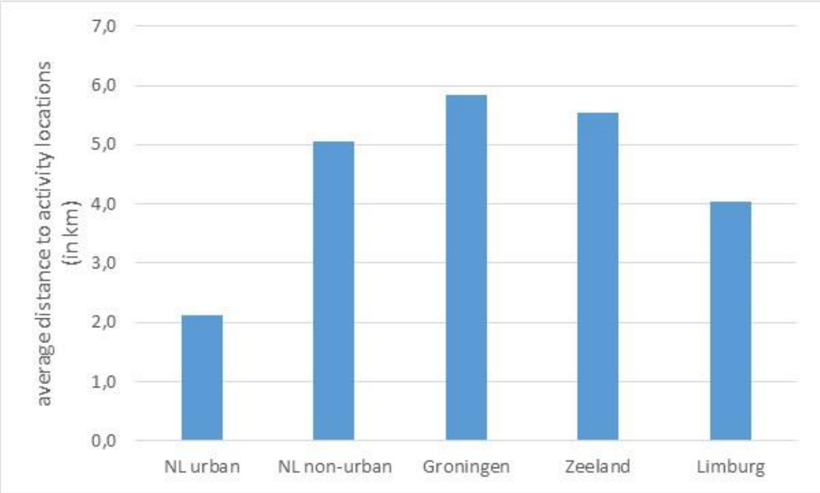


Figure 6: Average distance to the most important daily services in 2015.

Looking at the changes that occurred between 2008 and 2015 (Figure 7), we see small (but statistically significant) increases in the average distance to many facilities for the urban part of the Netherlands. The same picture arises for the small nuclei in the Netherlands. In the shrinkage areas of the three provinces, the change is noticeable, particularly in the distance to supermarkets, shops for daily facilities and primary schools. In the shrinkage areas of Zeeland and Groningen, distance to primary education has increased by almost a quarter.

A comparison has also been made between the small cores in the three provinces with and without population shrinkage. The image that emerges from this is varied in nature. In the province of Groningen, there is little difference between the shrinking and growing regions in terms of the change in average distance to facilities between 2008 and 2015. Exceptions are the distance to pharmacy, shops for daily facilities and primary education. In the shrinkage regions of Groningen, the distances to these facilities have increased significantly over the regions with population growth. In the province of Limburg, the average distances in the shrinkage areas have increased to education and the library compared to the growth areas. In Zeeland, a distance increase is visible in shrinkage areas to supermarkets and shops for daily facilities. That is not the case in regions with population growth.

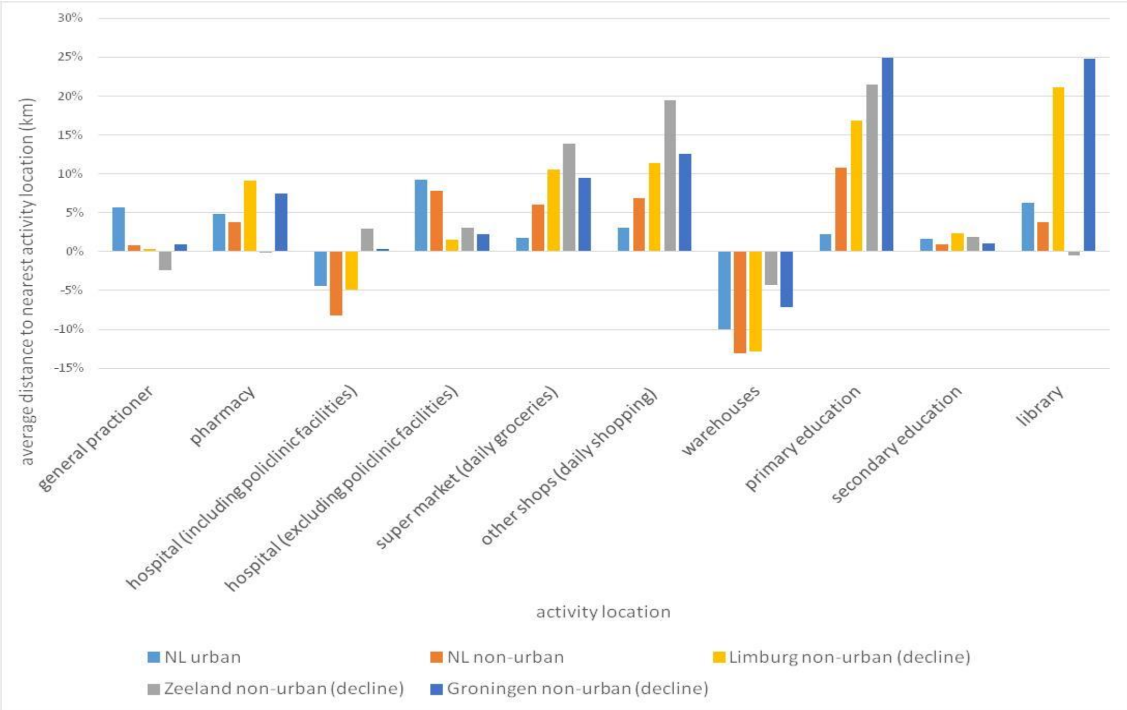


Figure 7: Changes in the average distance to the most important daily services (2008-2015).

In addition to the average distance to facilities, we also analyzed changes in the number of facilities within reach between 2008 and 2015, and whether that is correlated with a change in population decline. Table 1 gives an overview of the facilities considered and the distance classes used in the analysis. Overall, the results are comparable to the analysis using average distances as indicator. A small difference regards the accessibility of GP's. In the small cores of the areas of Zeeland with population decline, for example, no significant change in the number of GPs is visible, while a significant decrease has occurred in the small cores with population growth in Zeeland and in the rest of the Netherlands. Whereas we see a small deterioration in accessibility to hospitals (excluding policlinic facilities) in most parts of the Netherlands, this trend is not visible in the examined shrinkage and growth regions of the small cores in the three provinces, where hardly any change has occurred. There are also some positive developments. For example, the average number of secondary schools in reach in the Netherlands has increased significantly (both in growing and shrinking regions).

Finally, we conducted a correlation analysis between the population decline in the small cores (urbanization degree 4 and 5) of the three provinces on the one hand and the change of the average distance to the facilities and the number of facilities within reach on the other hand. For this purpose, correlation coefficients were calculated per category of supply. The analysis showed that almost all coefficients showed a very weak to weak coherence between the change in population and the change in accessibility of facilities.

4.2 Changes in travel patterns

In this section we first look at the changes in the total number of kilometres and trips per person in regions with and without population decline between 2005 and 2015 and also disentangle the impacts of changes in the volume of the population and in (individual) changes in travel behaviour[1]. Afterwards we further detail our analysis differentiating towards trip purpose and age.

Changes in total number of kilometers and trips

Tables 3 and 4 give an overview of changes in trip characteristics between (peripheral) regions with or without population decline. Both tables indicate that inhabitants of municipalities with population decline have increased their travel between 2005 and 2015. Both the number of kilometres and trips per person have increased. Moreover, the average length of trips has increased as well. Increases appear to be larger for the most peripheral regions that are already well known for their population decline. In declining non-urban parts of Groningen the number of kilometers/person have even increased by almost 12 percent in a decade. In regions with growth we see an opposite trend, with decreasing trips and kilometres per person. The trip length, however, also increases here.

Table 3: Relative changes (%) in trip characteristics between 2005 and 2015 for different regions (absolute changes within brackets).

Region	Change in trips/person	Change in km/person	Change in km/trip
Groningen (non-urban + decline)	7,8 (58)	11,6 (659)	3,6 (0,3)
Zeeland (non-urban + decline)	3,5 (29)	7,0 (460)	3,4 (0,3)
Limburg (non-urban + decline)	7,1 (54)	10,3 (540)	3,0 (0,2)
NL non-urban (decline + no decline)	2,4 (10)	4,2 (267)	3,0 (0,2)
NL urban	-6,0 (-52)	-2,9 (-185)	3,3 (0,2)

Table 4: Relative changes (%) in trip characteristics between 2005 and 2015 for municipalities with and without population decline (absolute changes within brackets).

Region	Change in trips/person	Change in km/person	Change in km/trip
NL decline (N = 151)	3,8 (30)	7,2 (421)	3,3 (0,25)
NL no decline (N = 242)	-6,3 (-54)	-3,2 (-211)	3,3 (0,24)

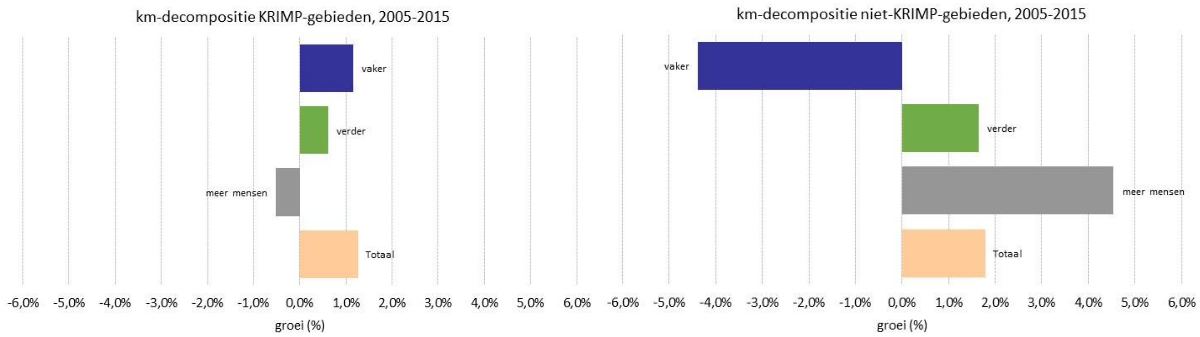
Whereas travel per person in declining regions has increased more than in parts of the country with growth, this does not mean that people in those regions travel more. If we take a snapshot of 2015 we see that people in the regions with growth (N=242) travel slightly more kilometres per person (about 1 percent), but make relatively fewer trips compared to shrinking regions (about 2 percent). It thus seems that there has rather

[1] Per municipality we only include trips that are made by inhabitants (one-way).

been a retrieval in travel in shrinking parts to the same level as in growing regions. If this trend would continue in the near future, travel per person in declining regions would be higher than in growing parts of the country.

To disentangle the impact of demographic and behavioural changes we decomposed the change in kilometres travelled between 2005 and 2015 into the contribution of population change (more or fewer people) and behavioural change (travel further and more often). Figure 8 indicates that both in shrinking and growing regions the total number of kilometres travelled has increased. The total growth in the country amounts to 3 percent (app. 1 percent in declining regions; 2 percent in growing regions). The population decrease in shrinking regions is fully compensated by people travelling more often and further. In contrast, the largest contribution to kilometres travelled in areas with growth is made by the larger population size. Whereas people in these region travel further they are found to travel less often.

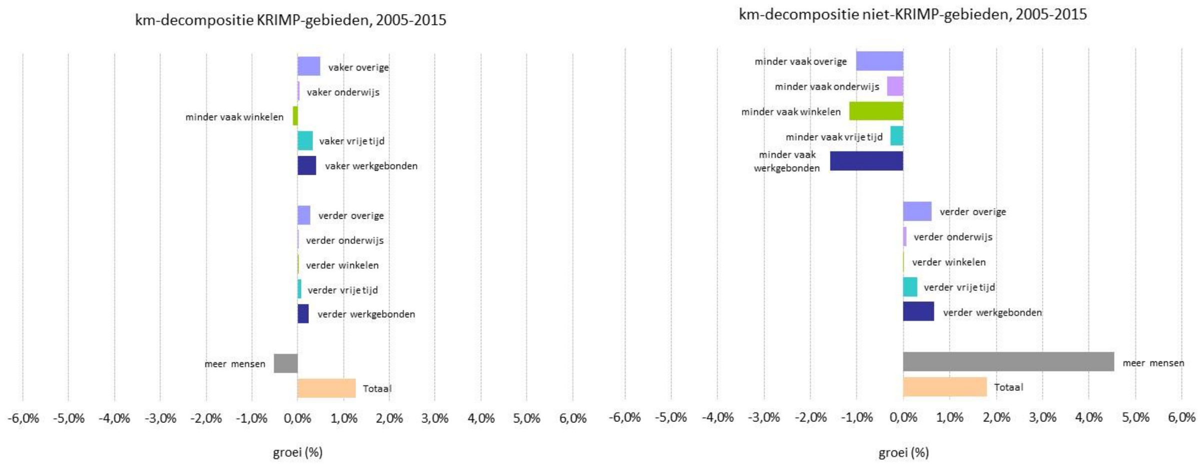
Figure 8: decomposition of the kilometre change between 2005 and 2015 in demography (more or fewer people), further (i.e. distance per trip) and more often (trips per person). Left: municipalities with decline (N = 151); right: municipalities with population growth.



<u>Differentiation towards trip purpose and age</u>

Figure 9 makes a subdivision into trip purposes. Generally speaking, we see comparable trends for the different motives. For regions with growth, fewer but longer trips are made with respect to all trip motives. The largest changes (both further and less often) can be observed for work related and other trips. In regions with decline more and longer trips are made with respect to almost all trip motives, with shopping being the exception. Both in regions with and without decline, people make fewer shopping trips in 2015 compared to 2005. This decrease is stronger in growing regions. This might be caused by an increase in online shopping.

Figure 9: *decomposition of the kilometre change between 2005 and 2015 and differentiation towards trip motives. Left: municipalities with decline (N = 151); right: municipalities with population growth.*



In comparable manner a subdivision into six age groups was made. For regions with population decline, we found that people of all ages make more trips per person in 2015 compared to 2005. Also most people travel further, with the group of 18-29 years being the only exception. Compared to 2005, people within this group travel more often, but slightly less far. This same trend is visible in regions with population growth. Also here young adults drive less far, but in contrast to shrinking regions also less often. For almost all age groups in growing regions we see a trend towards travelling further (i.e. except for young adults) but less often. The only people that consistently drive more often and further in 2015 are the ones of 65 and above. A potential explanation is that senior citizens have become healthier and more mobile (e.g., higher share of driving licenses).

5. Conclusions

In this paper we aimed to gain greater insight into the extent population decline has influenced the accessibility of activity locations and travel patterns in (peripheral) regions in the Netherlands. With respect to accessibility of activity locations (i.e. important services and facilities) we found that between 2008 and 2015 average distances have increased in the entire country. There are indications that the accessibility of services in more peripheral (and declining) regions has decreased more than in growing regions. Nevertheless, this was not confirmed by correlation analysis between population and accessibility change.

In addition, we analyzed how actual travel changed between 2005 and 2015. The number of trips and kilometres per person have substantially increased in regions facing population decline. In contrast, we see decreases in travel per person in growing regions, although the length of the trips have become larger in the entire country. In both growing and declining regions we see an overall increase in the number of kilometres travelled. In declining regions a lower number of kilometres due to a smaller population size is more than compensated by individuals travelling more often and further. At the same time, in growing regions, trip length has increased, but the number of trips per person has decreased. The population growth, however, more than compensates for the lower number of trips per person, resulting in a net increase in the number of kilometres driven in regions with population growth.

To more fully understand changes in travel, we intend to do additional research into changes in mode choice over time. What has for instance happened with public transport use in declining regions where some line services have been under pressure? And do we see different trends in car and bicycle use in declining and growing regions? These are questions that we intend to address in future research.

Whereas in this paper we presented more ‘objective’ insights of accessibility and travel characteristics, it would be valuable to also gain greater insight into the perceived accessibility of people living in regions with decline. How do inhabitants feel about the accessibility of important services in their region? Do they perceive transport related problems? Answering such questions are important to more fully understand relationships between travel, perceived accessibility and liveability of regions facing population decline.

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